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## A new *Rhodope* from the Roscoff area (Bretagne), with a review of *Rhodope* species

(Gastropoda: Nudibranchia?)

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*Rhodope roskoi*, spec. nov. is described from off Roscoff living on subtidal shelly gravel sediment. For the first time colour photos of *Rhodope* species are presented. All described and undescribed *Rhodope* species are comparatively reviewed. In addition, all published original information is compiled on this enigmatic genus, the systematic status of which is still uncertain.

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### Introduction

Up to now the genus *Rhodope* (Greek mythology: nymph of Thrace and wife of Haemus, changed into a mountain chain) or the family Rhodopidae respectively – remains one of the very few truly enigmatic taxa within the Gastropoda. Whereas its gastropod-euthyneuran (versus turbellarian) nature has been confirmed by Riedl (1960) after a century of heavy debate (see Riedl 1959 for review), its position among the euthyneuran clades is still unresolved: Haszprunar & Huber (1990) showed that *Rhodope* has an opisthobranch rather than an pulmonate nervous system. Salvini-Plawen (1991) concluded that Rhodopidae may represent an early, independent offshoot of Opisthobranchia, although more recent fine structural data suggest a placement within the doridoid Nudibranchia (Haszprunar & Künz 1996). Up to now all attempts failed to extract DNA out of a *Rhodope* specimen (M. Schrödl and H. Wägele, pers. comm.).

Species composition of *Rhodope* is also far from being cleared up. Up to now only three nominal species do exist: (1) *Rhodope veranii* Kölliker, 1847:

the type species: type material does not exist. Herein, we present the first colour photo of this species based on findings in an aquarium of the Zoological Institute of the University of Vienna (Austria) about 15 years ago by the senior author (GH). (2) *Rh. transtrossa* Salvini-Plawen, 1991 is based on material found by the senior author (GH) from a tropical aquarium in Vienna, Austria, thus without a locus typicus. (3) *Rh. marcusii* has been subsequently designated by Salvini-Plawen (1991) based on the description of Brazilian material by Marcus & Marcus (1952). Type material does not exist (M. Schrödl, pers. comm.).

*Rhodope crucispiculata* Salvini-Plawen, 1991 (based on Rieger & Sterrer 1975: p. 265, fig. 36; again without type material and distinct locus typicus) is excluded here, since its spicules differ substantially from all other *Rhodope* species (see Rieger & Sterrer 1975) and in our view probably represents a different genus of Rhodopidae.

In addition, a number of further species have been mentioned by various authors throughout the decades, most of them summarized in Arnaud et al. (1986) and Salvini-Plawen (1991). However, considering the lack of type material, we refrain from a

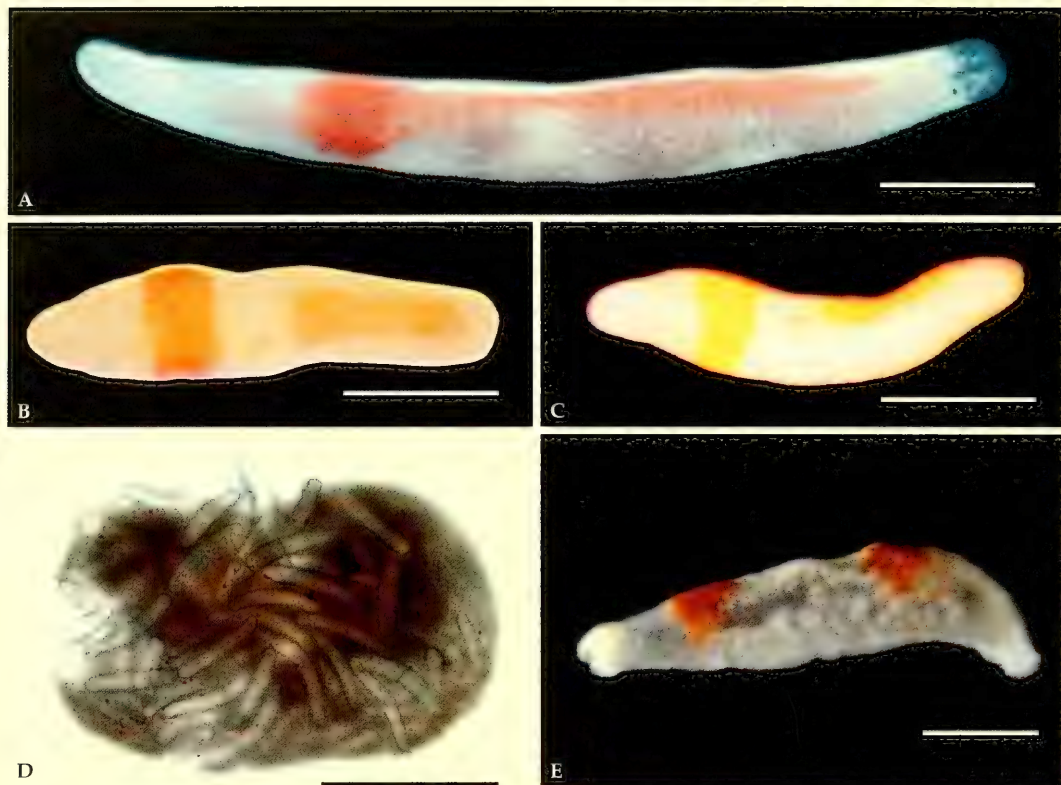


Fig. 1. A. *Rhodope veranii*, (photo: Maria Mizzaro-Wimmer), dorsal view. Bar=1 mm. B. *Rhodope roskoi* sp. nov., dorsal view. Bar=0.5 mm. C. *Rhodope roskoi* sp. nov., lateral view from the left. Bar=0.5 mm. D. *Rhodope roskoi* sp. nov., spicules from squeezed specimen. Bar=200  $\mu$ m. E. *Rhodope* sp. F of unknown locality (photo: Reinhard Kikinger, Feb. 6, 1992), lateral view from the left, eggs are visible through the semitransparent epidermis. Bar=1 mm.

formal description until new specimens will become available. This concerns (4) "*Rhodope veranii*" described by Karling (1966) from the Norwegian coast. (5) A further *Rhodope* has been mentioned by Carlson & Hoff (1981) at Guam in the Western Pacific. (6) A single, interstitial species of *Rhodope* was found 1972 by P. Schmidt (Aachen, Germany) from Galapagos (Arnaud et al. 1986). (7) *Rhodope* sp. from Westernport, Victoria, Australia (Burn, 1998). (8) We add here another *Rhodope* species (Tab. 1F) based on a single specimen again found 1992 in a tropical aquarium in Vienna of unknown original source. All these observations suggest that *Rhodope* is found worldwide in temperate to warm oceans and that several species await formal descriptions.

During a course on marine biology at the Station Biologique de Roscoff during the second half of May 2005 we dredged and investigated the interstitial fauna of shelly gravel ("sable de amphioxus") of about 25 m depth. Among other interesting molluscs (see below) we found three specimens of a *Rhodope*

which clearly differ from the type species. These specimens are described here as a species new to science.

#### *Rhodope roskoi*, spec. nov.

**Types.** Holotype: Subtidal (25 m) shelly gravel off Roscoff (at 48°43'532 N, 3°50'712 W), 29 May 2005, Martina Eder (student), G. Haszprunar (ZSM) – originally relaxed in an isotonic  $MgCl_2$  – solution and preserved for ultrastructural studies in 4 % glutaraldehyde buffered in 0.1 m cacodylate buffer, subsequently osmified, decalcified by 1 % ascorbid acid, dehydrated and embedded in Spurr's resin. The block is deposited in the Sektion Mollusca of the ZSM (# 20050859). – Two paratypes with the same data were also found in the same sample. The specimens were likewise relaxed but then preserved in 98 % pure ethanol (p.A.) for spicule images and future molecular studies. After slight squeezing for the spicule images these specimens are deposited in the original fixative without further treatment in the Sektion Mollusca of the ZSM (# 20050860).

## Description

As typical for the genus, *Rhodope roscoi* looks turbellarian-like at the first glance, but differs from the free-living flatworms by quite slow movements and the typical colour. There is no declined head and foot, the head region is somewhat laterally depressed, and an adhesive gland is present at the ventral rear of the body.

The size of living animals is about 1.5 mm; however, the animals heavily contract when they are disturbed or preserved. Whereas the principal colour (white body with orange pattern) is shared with several other *Rhodope* species, the distinct pattern clearly differs and is constant in all three specimens available: a broad horizontal girdle after the head

region surrounding the whole body and a separated, longitudinal stripe at the more posterior dorsal side (Fig. 1B,C, Tab. 1G).

In transparent light the small eyes, which are deeply embedded in the cephalic brain, the paired statocysts, and the spicules become visible. The spicules are slightly curved and verrucose. Their length ranges from 90 to 120  $\mu\text{m}$ , the majority has 100-115  $\mu\text{m}$  (Fig. 1D).

**Etymology.** The species is named after the Bretonian name of Roscoff (Rosko).

**Discussion.** The present species probably is identical to the one listed by Swedmark (1958) in the faunal list of the newly described polychaete *Psammodrilo-*

Tab. 1. Comparison of *Rhodope* species.

scheme	A	B	C	D	E	F	G
taxon	<i>veranii</i>	<i>transtrosa</i>	<i>marcusi</i>	<i>Rh. sp. D</i> "veranyi"	<i>Rh. sp. E</i>	<i>Rh. sp. F</i>	<i>roscoi</i>
source of scheme	Graff 1882, herein	Salvini- Plawen 1991	Marcus & Marcus 1952	Karling 1966	Burn 1998	herein	herein
body length (mm)	4-8	1.65	2	1.5	3	3-4	1.5
locus typicus	Messina, Mediterranean	? tropical	Bay of Santos, Brazil	Drivsund, Lille, Norway	Western- port, Victoria, Australia	? tropical	Roscoff, France
habitate	subtidal, among algae	?	intertidal among algae	shelly gravel, 25m	intertidal on <i>Zostera</i>	?	shelly gravel, 30-50m
length of spicules ( $\mu\text{m}$ )	90-120; (Graff: <130)	150-170	C-shaped, 50-130	70-80	?	?	90-120, mostly 100-115
diameter of spicules ( $\mu\text{m}$ )	7-14	about 12	?	7-9	?	?	10-20



*ides fauveli* as *Rhodope veranii*. However, the present specimens differ from *Rhodope veranii* (Fig. 1A) and all other described *Rhodope* species in the distinct orange pattern and pattern and the more densely arranged spicules, although the spicules themselves are similar to the type species. (Table 1).

**Biological notes.** Typically *Rhodope* has been found in the North-East Atlantic during meiofaunal studies (Swedmark 1958, Karling 1966, this study). However, *Rhodope veranii* inhabits shallow subtidal areas with *Ulva* or other green algae (Arnaud et al. 1986, Salvini-Plawen 1991; pers. obs. GH). Also *Rh. transtrosa* clearly is an epibenthic species in the darker part of the phytal. The same seems to be true for *Rhodope roskoi* despite of its small size: In the petri dishes with the extracted meiofauna they climb upwards rather than crawl downwards like nearly all other, truly interstitial animals in the same sample.

In the same sample of shelly gravel, which consists mainly of broken bivalve shells, we observed numerous specimens of amphioxus (*Branchiostoma lanceolatum*), of the polychaete *Polygordius lacteus*, of small sipunculans and holothurians, and of the prosobranch *Caecum glabrum*. Of particular interest are two different species of small, truly interstitial Solenogastres, which still have to be determined.

## Review of species and compilation of original data

Based on the turbellarian-like external appearance and its usually small size *Rhodope* is easily overlooked in malacological field work. Here we present an overview of all named and still unnamed species with a schematic drawing of the orange pattern (Tab. 1) in order to facilitate future findings. *Rhodope* sp. in Rieger & Sterrer (1975: pp. 263-265, figs 34-35) has been formally named *Helminthope psammobionta* Salvini-Plawen, 1991. As mentioned above *Rhodope crucispiculata* Salvini-Plawen, 1991 is excluded here.

We also compile all available original data on rhodopid species (Table 2) to stimulate future investigations, in particular further ultrastructural and molecular research on this enigmatic taxon.

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We thank the Station Biologique of Roscoff for hospitality during the course in May 2005. Thanks also to Martina Eder, who found the first specimen of *Rhodope roskoi* in the sample. Eva Lodde (ZSM) did the embedding work of the holotype. We are grateful to Maria Mizzarro-Wimmer and Reinhard Kikinger for provi-

Tab. 2. Original data on species of Rhodopidae (*Rhodope* and *Helminthope*) chronologically arranged.

Taxa	Content	Reference
<i>Rh. veranii</i>	external morphology	Kölliker 1847
<i>Rh. veranii</i> (as <i>Sidonia elegans</i> )	morphology, anatomy (poor and mostly wrong), spicules	Schultze 1854
<i>Rh. veranii</i>	anatomy, synonymy with <i>Sidonia elegans</i> Schultze, 1854	Graff 1882
<i>Rh. veranii</i>	morphology, biology	Trinchese 1887
<i>Rh. veranii</i>	anatomy, detailed histology	Böhmig 1893
<i>Rh. marcusii</i> (as <i>Rhodope veranyi</i> )	anatomy	Marcus & Marcus 1952
<i>Rh. veranii</i>	review of history, biology	Riedl 1959
<i>Rh. veranii</i>	detailed ontogeny	Riedl 1960
<i>Rhodope</i> sp. (as <i>Rh. veranyi</i> )	morphology, spicules, biology	Karling 1966
<i>Helminthope psammobionta</i> , <i>Rh. crucispiculata</i> (as <i>Rhodope</i> spp.)	light microscopy, TEM and drawing of spicules	Rieger & Sterrer 1975
<i>Rh. veranii</i>	details of nervous system	Haszprunar & Huber 1990
<i>Rh. veranii</i> , <i>Rh. transtrosa</i> , <i>Helminthope psammobionta</i>	taxonomy, morphology, anatomy, histology, chromosome number	Salvini-Plawen 1991
<i>Rh. veranii</i> , <i>Rh. transtrosa</i>	TEM of epidermis (with glands, phaosomes, bacteriocytes) and connective tissue (with rhogocytes, haemocytes, glands, vesicle system)	Künz & Haszprunar 1992, Haszprunar & Künz 1996
<i>Rh. transtrosa</i>	TEM of excretory organ	Haszprunar 1997

ding the photos of *Rhodope veranii* and *Rhodope* sp. respectively, and in particular to Luitfried v. Salvini-Plawen (all University of Vienna) for critically reading and improving the typescript.

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